THE VALUE OF PROJECT PLANNING AND CONTROL TECHNIQUES

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A great deal of emphasis has been placed upon the roles of project planning and control techniques in the field of project management. Among the tools and techniques employed, PERT and CPM have received the most emphasis. In fact, project management is often construed as synonymous with PERT-CPM as evidenced by one popular text entitled, Project Management with CPM and PERT.[2] How much do these planning and control techniques, and especially PERT and CPM, contribute to project success? If heavy emphasis is placed upon the extent of use of PERT-CPM, does this contribute to higher levels of success for a project? Is PERT-CPM the most valuable of the project planning and control techniques? The answers to these questions will surprise many readers.

What Constitutes Success for a Project?

Before we can answer these questions, however, we must ask an even more basic question: What constitutes success for a project? Project management literature has traditionally emphasized that the three most important variables of project management are time, cost, and technical performance. J. Stanley Baumgartner in his early book, Project Management stated that the purpose of project management is to produce deliverable items on time, within the contemplated cost, with the required reliability and performance, at a profit to the contractor.[3] If such is the case, then a "successful" project will be, by definition, one in which the original schedule is met or beaten, the original budget is met or underrun, and the technical requirements are met. Conversely,

project overruns the original budget and is very late, the project will not be perceived as successful. Is this true or false? Results of recent research indicate that this is often true but also often false.

The authors conducted a study believed to be the largest and most comprehensive investigation to date on the subject of project management effectiveness. A sample of 646 responses represented a variety of industries (34% manufacturing, 22% construction, 17% government, and 27% services, transportation and others). Most of the respondents themselves had been directly involved in the particular project they chose to describe in their questionnaire. Of the total sample, 50% had been the project manager, 31% had been in other positions on the project team, and another 10% had been the project manager's direct superior. About one-third of the projects were described as being public in nature, the remaining two-thirds being in the private sector. The types of contracts or agreements involved included cost plus fixed fee (32%), in-house work orders (28%), fixed price (21%), and fixed price with incentives (14%). The major activity or end product involved in the projects included construction (43%), hardware or equipment (22%), new processes or software (14%), and studies, services and tests (11%).

Of the three traditional project management variables, cost performance, schedule performance, and technical performance, only technical performance was integrally associated with "perceived success" of a project. "Perceived success" is the name given to a factor which included the following six items:

- Overall evaluation of project success
- Satisfaction of the parent
- Satisfaction of the client
- Satisfaction of the ultimate users, recipients, or clientele
- Satisfaction of the project team
- Fulfillment of the technical performance mission or function to be performed

It was found that the first item of the six above represented a fair overall

measure of perceived success. This is shown by the very strong correlations of this item with the others:

Satisfaction - parent	$r \geq .654$
Satisfaction - client	$r \geq .611$
Satisfaction - user	$r \geq .518$
Satisfaction - project team	$r \geq .646$
Technical performance	$r \geq .559$

Therefore, for the purposes of simple correlation analysis, it was felt that the single overall subjective measure would be an adequate index of success.

How did cost and schedule performance relate to the perceived failure and success projects? It was found that cost and schedule overrun were not included in a list of twenty-nine project management characteristics significantly related to perceived project failure. Conversely, good cost and schedule performance were not included in a list of twenty-three project management characteristics significantly related to perceived success. Nor were cost and schedule performance included in the list of ten project management characteristics found to be linearly related to both perceived success and perceived failure. If the study had been conducted solely upon aerospace projects, this might not have been too surprising, but aerospace projects represented less than 20% of the responses. For project managers and project personnel who have constantly lived with heavy emphasis upon meeting schedules and staying within budgets, this finding may be difficult to swallow. A partial explanation may be as follows: The survey was concerned only with completed projects. As perspective is developed upon a project, the ultimate satisfaction of the parent, the client, the ultimate users, and the project team is most closely related to whether the project end-item is performing as desired. A schedule delay and a budget overrun may seem somewhat unimportant as time goes on, in the face of a high degree of satisfaction and a sound foundation for future relationships. Conversely, few can legitimately claim that "the operation was a success but the patient died." If the survey had

been conducted for current, ongoing projects only, the management emphasis upon meeting schedules and staying within budgets probably would have been reflected much more heavily in the survey results.

The question then remains, what other factors contribute significantly to high levels of perceived success?

What is the Relative Value of Project Planning and Control Techniques to Perceived Success of a Project?

Due to the large number of variables included in the study, the technique of factor analysis was used to reduce the data to a smaller set of underlying dimensions. An additional benefit of the factor analysis technique is that it allows us to see what the major dimensions are that comprise the world of project management. A noteworthy result of the factor analysis was the large number of factors produced. Thirty-two meaningful factors were identified. This shows the multi-dimensional complexity of the project management "world."

To examine the surface relationships of the factors with success, the correlations of the Perceived Success factor already mentioned and the remaining factors were considered. Using product-moment correlation, it was found that the factor, Adequacy of Project Structure and Control strongly affected success. The correlation coefficient was +.81. The factor included:

- The project manager's satisfaction with the project planning and control system, and
- The project team's satisfaction with the project organizational structure.

Note that this implies that the important point is not what tools are used, or how much they are used, but how appropriate they are to the task at hand. The same reasoning applies to the type of organizational structure employed.

Another factor which strongly affected success was Systems Approaches.

The correlation coefficient was +.56 and included the following items:

- Value of work breakdown structures,
- Extent work breakdown structures were used,
- Extent systems management concepts were used,
- Value of systems management concepts,
- Extent status and progress reports were used.

Correlation of the factor, Networking Systems, was not significantly related to the Perceived Success factor.

The findings reported above are based upon simple factor correlation, the extent to which variation in any one given factor tends to be associated with variation in the perceived success factor, with no consideration given to the effects of any of the other factors. Simple correlation analysis leaves unanswered the question of whether several of the factors, taken together in combination, would explain a larger portion of the variance in the Perceived Success factor than would any one factor by itself. Since the research indicates that perceived success results not from any one factor alone, but from a combination of many factors, a further test of the data, beyond simple correlation analysis, was necessary.

Exhibit I shows the relative importance of the factors contributing to project success as derived from a stepwise multiple regression analysis in which the Perceived Success factor was the dependent variable and all of the other factors were independent variables. The independent variable with the highest partial correlation at the conclusion of each step was the variable entered into the equation in the next step. This form of analysis yields a list of those factors, each of which makes a significant independent contribution toward explaining project success, after allowance has been made for the effects of the other factors.

It should be re-emphasized that technical performance was integrally

associated with success and was part of the Perceived Success factor itself. Beyond technical performance, however, what are the principal factors contributing to project success?

Exhibit I shows that the strongest seven of the determining factors explained 91% of the variance in the Perceived Success factor. The makeup of these seven factors is shown in Exhibit II. Note the extremely important impact of coordination and relations patterns. Success Criteria Salience and Consensus and avoidance of Initial Over-Optimism, Conceptual Difficulty were the next two heaviest weighted factors in the regression equation. Note also that although the factor, Adequacy of Project Structure and Control is included in the seven principal factors contributing to Perceived Success neither the Systems Approaches factor nor the Networking Systems factor were included in Exhibit I. Should the reader therefore conclude that it is not worthwhile to employ systems approaches and networking systems in project management?

The research does not support such a drastic conclusion.

What is the Appropriate Role of Systems Approaches and Networking Systems in Project Management?

The question above was purposely not stated, "What is the role of systems approaches and networking systems for perceived success of a project?"

As project management tools, these factors do contribute to effective overall performance, if not to perceived success, as such. The research supports the value of systems approaches and networking systems when used appropriately. The over-use of PERT-CPM systems was found to hamper success. It was the judicious use of PERT-CPM which was associated with success. An important military satellite program was actually hampered by early reliance

upon a network that covered four walls of a large conference room. The tool was too cumbersome and consumed too much time to maintain it. Fortunately, someone decided that the network was a classified document and ordered curtains to be placed over the network. Once the curtains were up, they were never drawn again and the project proceeded as planned. The value of systems approaches was found to be more significant than networking systems with respect to project management effectiveness.

A path analysis revealed situations under which the usage of systems approaches and networking systems is especially important. Path analysis is a relatively new analytic technique and should not be confused with networking techniques such as PERT and CPM. The result of path analysis is a model which explains the interaction of a large number of variables. Such a model illustrates the causal relationships contained in a network of relationships. The strength of these relationships are measured by path coefficients. These coefficients are standardized measures which can be compared to determine the relative predictive power of each independent variable with the effects of other variables held constant. The particular value of path analysis is that it illustrates the working relationships of many variables in a network of relative predictive powers; thus allowing one to understand the relationships among variables in a systematic manner.

The path analysis revealed that usage of systems approaches and networking systems is especially important when:

- Initial over-optimism has occurred,
- Buy-ins have occurred,
- Success criteria salience and consensus is lacking,
- Good schedule and cost performance are critical.

Therefore, these project planning tools and techniques <u>are</u> important to project management, but they should be placed in proper perspective, especially

in the perspective of their contribution to the long run perceived success of a project. The importance of PERT-CPM to perceived success of a project is far outweighed by a host of other factors.

Conclusions

The following conclusions seem to be warranted from the research:

1. Project management has tended to overemphasize the roles of cost and schedule control techniques, especially PERT-CPM, with respect to their contribution to project success.

2. Technical performance is integrally associated with perceived success of a project, whereas cost and schedule performance are somewhat less intimately associated with perceived success.

3. In the long run, what really matters is whether the parties associated with, and affected by a project, are satisfied. Good schedule and cost performance mean very little in the face of a poor performing end product.

4. Next to technical performance and satisfaction of those associated with and affected by a project, coordinations and relations is the most important factor contributing to perceived project success.

5. It appears to be important to use project planning and control techniques in an adequate and judicious manner. It is the value of project planning and control techniques, as opposed to the extent of use, which contributes to perceived project success.

6. Among the project planning and control techniques, as such, systems approaches were found to be more valuable than PERT-CPM.

7. PERT-CPM, when overused, actually hampers project success.

8. PERT-CPM does contribute to project success when used judiciously.

9. It is especially important to use PERT-CPM when cost and schedule performance are considered most critical. PERT-CPM are essential tools when over-optimism and/or "buy-in" patterns have occurred. The judicious usage of PERT-CPM is associated with good cost and schedule performance.

10. The value of project planning and control techniques should be placed in more appropriate perspective among project management factors contributing to success. In perspective, their value is far less than a host of other factors.

FOOTNOTES

[1]The study reported in this paper was conducted under the sponsorship of the National Aeronautics and Space Administration, NGR 22-03-028. The complete report is entitled, Determinants of Project Success, by David C. Murphy, Bruce N. Baker, and Dalmar Fisher. It may be obtained from the National Technical Information System, Springfield, VA, 22151, by referencing the title and the Accession number: N-74-30392, September 15, 1974.

[2]Joseph J. Moder and Cecil R. Phillips, Project Management with CPM and PERT, New York, N. Y.: Van Nostrand Reinhold Company, 1970.

[3]J. Stanley Baumgartner, Project Management, Homewood, Illinois: The Richard D. Irwin Co., 1963, p. 8.

EXHIBIT I

THE RELATIVE IMPORTANCE OF THE FACTORS
CONTRIBUTING TO PROJECT SUCCESS

Multiple Regression Results

Determining Factors	Standardized Regression Coefficient	Significance	Cumulative R^2
Coordination and Relations	+.347	$p<.001$	.773
Adequacy of Project Structure and Control	+.187	$p<.001$	.830
Project Uniqueness, Importance, and Public Exposure	+.145	$p<.001$	.877
Success Criteria Salience and Consensus	+.254	$p<.001$	.886
Competitive and Budgetary Pressure	-.153	$p<.001$	.897
Initial Over-Optimism, Conceptual Difficulty	-.215	$p<.001$	.905
Internal Capabilities Buildup	+.084	$p<.001$	.911

EXHIBIT II

ITEMS INCLUDED IN THE SEVEN FACTORS OF EXHIBIT I

Coordination & Relations Factor
- Unity between project manager and contributing department managers
- Project team spirit
- Project team sense of mission
- Project team goal commitment
- Project team capability
- Unity between project manager and public officials
- Unity between project manager and client contact
- Unity between project manager and his superior
- Project manager's human skills
- Realistic progress reports
- Project manager's administrative skills
- Supportive informal relations of team members
- Authority of project manager
- Adequacy of change procedures
- Job security of project team
- Project team participation in decision making
- Project team participation in major problem solving
- Parent enthusiasm
- Availability of back-up strategies

Adequacy of Project Structure and Control Factor
- Project manager's satisfaction with planning and control
- Team's satisfaction with organization structure

Project Uniqueness, Importance and Public Exposure Factor
- Extent of public enthusiasm
- Project larger in scale than most
- Initial importance of state-of-art advancement
- Project was different than most
- Parent experience with similar project scope
- Favorability of media coverage

Success Criteria Salience and Consensus Factor
- Importance to project manager - budget
- Importance to project manager - schedule
- Importance to parent - budget
- Importance to parent - schedule
- Importance to client - budget
- Importance to client - schedule
- Importance to client - technical performance
- Importance to parent - technical performance
- Importance to project manager - technical performance

Competitive and Budgetary Pressure Factor (Negative Impact)
- Fixed price (as opposed to cost reimbursement) type of contract
- Highly competitive environment
- Parent heavy emphasis upon staying within the budget
- Project manager heavy emphasis upon staying within the budget
- Client heavy emphasis upon staying within the budget

EXHIBIT II

Initial Over-Optimism, Conceptual Difficulty Factor (Negative Impact)
- Difficulty in meeting project schedules
- Difficulty of staying within original budget
- Original cost estimates too optimistic
- Difficulty in meeting technical requirements
- Project was more complex than initially conceived
- Schedule overrun
- Difficulty in freezing design
- Unrealistic schedules
- Project was different than most

Internal Capabilities Build-Up Factor
- Extent to which project built up parent capabilities
- Original total budget
- Total cost of project